IEG/PHD-8-69
14 January 1969

MEMORANDUM FOR THE RECORD

SUBJECT: Trip Report by [redacted] for the Period of 2 - 6 December 1968 25X1

1. Trip was made to the [redacted] in the company of [redacted] (TSSG/DED), [redacted] (TSSG/APSD) and [redacted] (IEG/PHD), and was for the purpose of receiving "on-the-site" briefings on the High Precision Stereo Comparator. [redacted] made the trip in his responsibility of project monitor. The other individuals primary interest was to obtain operating and programming information specifically pointed towards PHD's interest in the computing aspects of the instrument. 25X1 25X1 25X1 25X1 25X1 25X1

2. On the trip out to [redacted] the group accompanied [redacted] to Los Angeles on December 2, 1968 to visit [redacted] of the [redacted] who has been retained at times by NPIC as a consultant on photogrammetric equipment design. Nothing of direct interest to PHD occurred except for a demonstration of a prototype light table and power driven film winding mechanism. The light table seemed to be an advance over those in use at NPIC in that its maximum light level is quite a bit higher and its film winding mechanism is very responsive to its controls and runs quietly. 25X1 25X1 25X1 25X1

3. The days of 3 and 4 December were spent at briefings by [redacted] These briefings are covered in attachment "A." On 5 December Mr. [redacted] accompanied [redacted] of the [redacted] staff to the [redacted] officies on the [redacted] campus [redacted] to obtain information on their [redacted] Photo Comparator System. This high precision instrument has an unique high precision measurement system unlike that of any other known design that might be of interest to PHD. Discussions of this part of the trip are covered in attachment "B." As the trip to [redacted] was the last objective of this TDY, return to Washington was made on 6 December. 25X1 25X1 25X1 25X1 25X1 25X1 25X1 25X1 25X1 25X1

[redacted] 25X1

Deputy Chief, Photogrammetry Division, IEG/NPIC

Distribution:
1 - NPIC/IEG
[illegible] - NPIC/TSSG
2 - NPIC/IEG/PHD

Attachment A

25X1 The briefings at the [redacted] plant followed the included agenda quite closely except that, because of the informal approach, the various topics tended to overlap somewhat. However, reviewing the briefings in the order of the agenda will result in adequate coverage of all points.

The first significant discussion was [redacted] review of 25X1
the production schedule. He pointed out here, as has also been noted in their monthly reports, that there has been significant delay in the critical path item, namely the manufacture of the optics. At present it looks as if the delay will be at least the six months forcasted earlier. [redacted] also reviewed the 25X1
optical design from the standpoint of the necessary interactions of the optical components and the computerized operating programs necessary to effect their coordination. Further, [redacted] dis- 25X1
cussed the true nature of a reticule dot small enough to be near the diffraction limit. There is not much experience with such small reticules and there may be unexpected characteristics that will require additional optical design and adjustments to make them satisfactory.

25X1 Finally, [redacted] reviewed the steps that will be taken to assure that the optical bridge built by [redacted] will fit the parts 25X1
of the comparator built in this country. Essentially it consists of making a set of matching metal templets that will locate match pins and holes in the separate components as accurately as machine shop techniques can make possible. This is a good, widely accepted practice that is often used to assure fits, to close tolerances, of machinery components manufactured at different locations.

The highlight of the plant tour was the observation of the placement of the major components of the comparator. The two granite stage blocks were mounted on the frame and the various major housings of the optical bridge were either in place or close at hand. Also, the assembly had been mounted on the air vibration dampeners and some stabilization tests had been made. The wooden mock up was removed from the area, so this skelton major component assembly was the only thing available to give an overall impression of the instrument. It follows the mock up very closely and indicates that the finished configuration will be quite close to the working design.

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One impression gained from the tour was that as much work was
being carried on at one time as was possible. Many of the indi-
vidual components were under work at separate locations, being
designed, fabricated and tested so that when fitted into the in-
strument, they would be a reliable working part.

After lunch on 4 December, [redacted] 25X1
discussed that portion of the programming effort needed to accomplish
the internal working of the instrument. A copy of the list of various
programs involved is included with this attachment. This discussion
was pointed towards informing [redacted] of PHD and [redacted] of TSSG/ STAT
PASD/ISAB of the relationships between the various parts of these
programs and defining the terminology. Related to this discussion 25X1
was a review of the keyboard functions, their relation to the programs
and to the operations of the comparator. It was obvious from this
discussion that the real know-how to run the comparator effectively
will have to be acquired from actual operation and that "dry run"
instruction courses in its operations will not be adequate. Mr.
25X1 [redacted] helped [redacted] in this discussion, 25X1
which lasted until quitting time on 3 December 1968.

25X1 On 4 December, [redacted] gave a further review of the schedule
25X1 for [redacted] benefit. As part of this discussion, the spare
parts kit was outlined. The selection of the parts in this proposed
kit is made on two basis. One basis is to include all parts that would
be difficult to get in case of needed replacement, such as the one
25X1 case of a [redacted] manufactured motor. The other type of part is the
parts that, while easy to obtain, do not have a long life expectancy,
such as bulbs, capacitors, resistors, etc. Also included will be one
set of spare glass stage platen and blanks for many of the various
optical elements. In case of required replacement of such optics, the
new ones will have to be individually ground, which will mean a long
down time. However, having the blanks available it will be possible
to make a replacement lens whereas without them it might have to be
necessary to replace the whole affected component. Following this,
there was some discussion on the Operation Manual. [redacted] presented 25X1
an outline that indicated that [redacted] was going unnecessarily deep into 25X1
photogrammetric principals, camera systems, and mathematics. Much of
this material would be "old hat" to any PHD personnel assigned to
25X1 operate the instrument. [redacted] was given this viewpoint with the sug-
gestion that they cut back on some of these aspects and refer to them
only when necessary to make an explanation of the instrument's opera-
tion clear. Otherwise, their outline was very good. If the text is
as indicated the manual will be complete. Another manual will be a
malfunction tracer to aid the NPIC in-house maintenance personnel to
locate trouble and determine what correction steps are necessary.

Associated with this was a discussion about the [redacted] viewpoint on training maintenance personnel. They do not believe that it is enough to have these individuals present during the final installation and check out operations. They feel that at least a two-week instruction at their plant during the final fabrication stage is advisable. [redacted] also strongly recommended that a preventative maintenance contract be initiated to take effect upon delivery of the instrument, the same as was done for the Dual Screen Measuring Device (DSMP). It is true that the warranty period for the first year assures maintenance in case of malfunction but it does not provide for normal preventative maintenance. Such maintenance involves making adjustments, calibrations and replacing parts needed to prevent breakdown after the end of this warranty period. The use of this type of contract for the DSMP proved to be good insurance against this very problem. 25X1 25X1

During the general question and answer period following the end of the agenda discussion, [redacted] outlined the relationships between the operator's actions and the employment of the various programs. He brought out that they might achieve the very desirable capability of being able to maintain storage of the programs for all three camera types in the instrument computer at one time. If so, this would eliminate the need to load programs through the paper tape reader when changing system materials. He seem sure that in any event, at least two programs can co-exist in the computer's memory and, unless some unexpected development occurs, there will be room for the third one. If this is possible, normal operation of the instrument will be faster and simpler from the production viewpoint. With this discussion, the [redacted] briefing was completed. 25X1 25X1

Attachment B

25X1 The trip to the [redacted] offices at the [redacted] 25X1
25X1 [redacted] was to gain first-hand knowledge of
25X1 their [redacted] Photo Comparator System. Short descriptions of this system in scientific journals indicated that it is of unusual design and might have features that could be applied to NPIC instrumentation. The instrument has been described as one micrometer comparator capable of measuring over an 18" x 18" area and operates in a semi-automatic mode.

Actually, the system includes two separate comparators and an electronic monitor/control unit. The two comparators are not duplicates. One is a 50 micrometer least count machine that has two stages, but no stereo viewing capability. It is used as a "survey" machine to roughly locate the star images on the 18" x 18" glass plates and produce a punched card of the coordinates of this rough location. These cards are then used to control the other, or high precision comparator. The twin stages of the "survey" comparator are for comparison of two photos of a star field to detect relative star movements and thereby aid in the selection of the stars to be measured. There is no capability for stereo viewing of the two plates in this instrument. Rather, a flicker" arrangement is used that alternately presents the left and right plates to the viewer.

After the desired star images have been located and their X and Y coordinates punched on cards, the latter of the two star field photo plates is placed on the high precision comparator. This instrument is in a temperature humidity stable room, isolated from the operator during a measurement operation. Operator inspection of the measurements is maintained through the monitor console which includes a closed circuit T.V. view of the reticule and image area being measured. The operation of the high precision comparator is basically controlled by the card deck from the "survey" instrument. These cards are fed into a card reader which drives the high precision instrument reticule to the general location of the star being measured. Then, through a photo electric cell control the high precision comparator locks onto the star and centers it in the reticule. When the centering operation is completed, another card punch punches a new card with the precision coordinates.

The uniqueness of both comparators is the measuring system, which was designed about 10 years ago before laser interferometers had been demonstrated to be reliable. The objective of the design was to have a measurement system entirely free of troubles from mechanical wear. It uses a quartz like cylinder in place of the accurately ground screw. This cylinder has placed on it an accurate single helical strip of silver with several centimeters pitch. The normal nut part of the standard precision measuring screw is replaced with a photo electrical cell unit. As the spiral is turned for measurement, the stage is driven by a separate motor drive so that the photo cell follows the silvered helical strip on the cylinder. This arrangement is used to control the movements accurately to milimeters. Between milimeter positions, finer positioning is controlled by an optical wedge. These two components work in correlation with each and maintain the micrometer accuracy without any critical mechanical contact between the stage and its measuring mechanism. A full description of the instrument will be published shortly and will give all details of design and operation.

25X1 [redacted] the director of the star measuring program, considers that in its 18 months of operation, this system has been very satisfactorily. He indicated, without actually committing himself, that they would have used laser interferometry instead, if they had firm evidence that it would be reliable. However, at the time the instrument was designed, laser interferometry was still really no more than a laboratory experiment.

The use of a "survey" comparator is operated in normal room atmosphere while the high precision one is in a carefully controlled area. This room does not have any prevision for dust control, other than normal high quality air conditioner filters. However, humidity is held to a $\pm5\%$ range and temperature to $\pm2^{o}F$. Personnel do not remain in the room for any more time than needed to change photographic plates which eliminates the need for an air bath.

A reasonable opinion of their set-up could be that the unique measuring system, while good, is not the equal of present day laser interferometry systems and should not be applied to NPIC equipment. However, their use of a "survey" comparator lends support to the proposal that PHD utilize a Fiber Optic Stereo Measuring Device as an auxiliary to the High Precision Stereo Comparator. In the same manner as the [redacted] operation, this Fiber Optic instrument could be used for measurement planning viewing, area study, time track measuring, etc., and the precision measurement be done on the big comparator. This would save a lot of operational weare on the big comparator, and probably decrease the calender time spent on High Precision Stereo Comparator measuring projects. 25X1

Program for Customer Meeting - Job #342
December 3 and 4, 1968

December 3, 1968

9:00 a.m.	Meet in [redacted] office. 25X1 (4 customer representatives, [redacted] 25X1
9:15 a.m.	Meet in Conference Room Review of schedules - [redacted] 25X1
9:45 a.m.	Plant tour and visit to electronic checkout operations - [redacted] 25X1
10:30 a.m.	Review of keyboard functions of the Stereocomparator - [redacted] 25X1
12:00 noon	Lunch
1:30 p.m.	Review of computer program progress - [redacted] 25X1
2:00p.m. til end of day.	Review of computer program objectives - [redacted] 25X1

December 4, 1968

9:00 a.m.	Meet in Conference Room and discuss objectives of test target design - [redacted] 25X1
10:00 a.m.	Review of Instruction Manual objectives and general formats - [redacted] 25X1
12:00 noon	Lunch
1:30 p.m. til end of day.	Discussion of Project details as required [redacted]

25X1

EXEC1 (100%)

I. MSGIN (100%)

II. MSGOUT (100%)

III. DATAIN (50%)

IV. NOCAM (0%)

A. RECIN

V. PARMOD (50%)

A. RECIN (IV.A)

B. TTIN (0%)

C. TBSRCH (0%)

1. MSGCMP (0%)

D. SCANER (100%)

E. CONVU (50%)

VI. STAGIN (0%)

A. RDST (100%)

B. FID1 (50%)

C. EXINA

D. FID2 (50%)

E. RECALL (100%)

1. RDST (VI.A)

F. TTIC (25%)

EXEC2 (100%)

I. EXINA

A. MSGIN (100%)

B. MSGOUT (100%)

1. O$AP

2. O$AC

3. O$AF

II. RECALL (100%)

A. EXINA (I)

B. RDST (100%)

C. MSGOUT (I.B)

III. RDST (II,B)

IV. CVF (50%)

V. REORT (0%)

A. CAMATS (0%)

1. TICT (100%)

2. SIN, COS, SQRT

B. XMX1 (100%)

1. SIN, COS, TAN

C. TMAT (25%)

1. CAMATS (V,A)

2. MTS (100%)

a. TICX (100%)

b. TAN, COS

c. T2PAN (50%)

(1) YMR (100%)

(2) ATAN

3. PTOP (25%)

a. XMX1 (V,B)

b. TAN, ATAN, COS, SIN, SQRT

4. CVB (100%)

D. LSTC (100%)

E. RDOP (100%)

1. EXINA (I)

VI. EXSKS

A. MSGIN (I,A)

B. MSGOUT (I,B)

VII. GTP (100%)

A. SIN, COS

VIII. TRK (75%)

A. RDST (II,B)

B. RDOP (V,E)

C. RDCR (0%)

IX. FIXR (100%)